Listing of the Claims

1. (Original) A process for analyzing particles, including:

moving multiple particles serially along a predetermined path;

irradiating each particle with excitation energy as it traverses the path, wherein the excitation energy comprises energy at a first excitation frequency selected to cause a responsive emission depending on particle composition;

in connection with each irradiation of a particle, sensing for a responsive emission to determine an emissive response profile associated with the particle; and

selecting, for further analysis, only the particles associated with emissive response profiles that coincide with a predetermined reference profile.

2. (Original) The process of claim 1 further including:

after selecting the particles, performing the further analysis on the selected particles.

3. (Original) The process of claim 2 wherein:

the further analysis comprises irradiating each of the selected particles with ablation energy to desorb and ionize the particle.

4. (Original) The process of claim 3 wherein:

the further analysis comprises time-of-flight mass spectrometry.

5. (Original) The process of claim 1 wherein:

said irradiating of each particle includes causing a first beam of excitation energy at the first excitation frequency to intersect the predetermined path at a first location.

6. (Original) The process of claim 5 wherein:

said irradiating further includes causing a second beam of excitation frequency at a second frequency to intersect the predetermined path at a location downstream of the first location, wherein the second excitation frequency is selected to trigger a second responsive emission depending on particle composition; and

said sensing includes determining the emissive response profile based on the first and second responsive emissions.

7. (Original) The process of claim 1 wherein:

said moving of the multiple particles comprises drawing an aerosol including the particles along the predetermined path.

8. (Original) The process of claim 1 further including:

measuring the sizes of at least the selected particles, based on a characteristic selected from the group consisting of: an intensity of light scattered by each particle; and a time-of-flight for each of the particles between first and second locations along the predetermined path.

9. (Original) The process of claim 1 wherein:

said selecting includes measuring particles of a known composition to create the predetermined profile, and comparing the emissive response profiles of particles under test to the predetermined profile.

10. (Original) The process of claim 1 further including:

sensing for responsive emissions with respect to multiple particles, and using the results of the multiple sensing episodes to provide a cumulative emission response profile.

11. (Currently Amended) The process of claim 1 wherein:

the ~~first beam of~~ excitation energy has a wavelength within a range from about 260 to about 420 nm.

12. (Original) The process of claim 1 wherein:

said sensing for the first responsive emission consists essentially of sensing for fluorescent energy.

13. (Original) The process of claim 12 wherein:

the first emissive response includes fluorescent energy at a plurality of different wavelengths, and said sensing for the responsive emission includes using separate sensors or detecting channels to individually detect the different wavelengths.

14. (Original) The process of claim 1 wherein:

said selecting comprises using detectors sensitive only to fluorescent energy, whereby the step of selecting for further analysis is performed only on particles that emit fluorescent energy in response to said irradiating.

15. (Original) A system for analyzing particles, including:

a flow generating device for moving a particle-containing fluid along a designated path to carry the particles serially along the dedicated path;

an excitation component for providing excitation energy comprising energy at a first excitation frequency selected to cause a responsive emission depending on particle composition, and for irradiating the particles individually as they traverse the designated path;

a sensing component adapted to detect responsive emissions, operative in response to each irradiation of a particle to determine an emissive response profile associated with the particle; and

a selecting component adapted to select for further analysis only the particles with associated emissive response profiles that coincide with a predetermined reference profile.

16. (Original) The system of claim 15 further including:

a particle analyzing instrument disposed along the designated path.

17. (Original) The system of claim 16 wherein:

the instrument comprises an ablation energy source adapted to desorb and ionize the selected particles.

18. (Original) The system of claim 16 wherein:

the instrument comprises a time-of-flight mass spectrometer.

19. (Original) The system of claim 15 wherein:

the fluid comprises a gas.

20. (Currently Amended) The system of claim 19 further including:

a filtered air source for providing a sheath flow to surround the ~~aerosol~~ gas and flow with the ~~aerosol~~ gas as it moves along the designated path.

21. (Original) The system of claim 15 further including:

a particle sizing component comprising a detector for measuring an intensity of coherent energy scattered by each particle.

22. (Currently Amended) The system of claim 15 further including:

~~the~~ a particle sizing component comprising a means for timing the travel of each particle from a first location to a second location along the designated path.

23. (Original) The system of claim 15 wherein:

the excitation component is adapted to generate a first coherent energy beam at the first excitation wavelength, and a second coherent energy beam at the second and different excitation wavelength.

24. (Original) The system of claim 23 wherein:

the sensing component comprises a first detector responsive to energy in a first emissive wavelength range, and a second detector responsive to energy in a second emissive energy wavelength range.

25. (Original) The system of claim 24 further including:

an optical element for receiving the responsive emission, and providing a first selected wavelength region of the responsive emission to the first detector and a second selected wavelength region of the responsive emission to the second detector.

26. (Original) The system of claim 15 wherein:

the selecting component includes a first data storage field for dynamically storing emissive response profiles, a second data storage field for storing the predetermined reference profile, comparator logic operably associated with the first and second data storage fields for determining whether the data contained in the first and second fields coincide, and a selector adapted to select a given particle in the event of a coincidence determination.

27. (Original) The system of claim 15 wherein:

the sensing component is adapted to measure amplitudes of the responsive emissions.

28. (Original) A process for characterizing particles with controlled coherent energy sources, including:

moving multiple particles serially along a predetermined path;

generating a first coherent energy beam using a first source operable to adjust the first beam between a first state comprising a high amplitude operating mode and a second state comprising either a low amplitude operating mode or an inactive state;

generating a second coherent energy beam using a second source operable to adjust the second beam between a first state comprising a high amplitude operating mode and a second state comprising either a low amplitude operating mode or an inactive state;

while maintaining the first beam primarily in the first state, causing the first beam to intersect the predetermined path at a first location to irradiate each particle as it travels past the first location;

causing the second beam to intersect the predetermined path at a second location downstream of the first location, whereby the second beam is positioned to irradiate each particle as it passes the second location;

with respect to each particle, detecting a first response comprising radiant energy emanating from the particle in response to irradiation by the first beam; and

responsive to detecting the first response, and before the particle reaches the second location, operating the first source to switch the first beam from the first state to the second state.

29. (Original) The process of claim 28 further including:

maintaining the second beam primarily in the second state, and further responsive to detecting the first response, operating the second source to switch the second beam from the second state to the first state.

30. (Original) The process of claim 29 wherein:

said operating the first and second sources is performed after a predetermined delay following detection of the first response.

31. (Original) The process of claim 29 further including:

after said operating the first and second sources, further operating the first and second sources to reset the first beam to the first state and reset the second beam to the second state.

32. (Original) The process of claim 29 further including:

detecting a second response comprising radiant energy emanating from the particle in response to the irradiation by the second beam; and

responsive to detecting the second response, operating the first source to reset the first beam from the second state to the first state.

33. (Original) The process of claim 32 further including:

operating the second source to reset the second beam to the second state, responsive to detecting the second response.

34. (Original) The process of claim 33 wherein:

said resetting of the first and second beams is performed substantially simultaneously with detecting the second response.

35. (Original) The process of claim 32 wherein:

detecting the second response consists essentially of one of the following: (i) detecting energy scattered by the particle when at the second location; and (ii) detecting fluorescent energy emitted by the particle when at the second location.

36. (Original) The process of claim 32 wherein:

detecting the first and second responses is accomplished with a single detector.

37. (Original) The process of claim 32 wherein:

the second response includes a scattered energy component and a fluorescent energy component, and detecting the first response and the second response comprises using a first sensor to detect energy scattered by the particle at the first and second locations, and using a second sensor to detect the fluorescent energy component.

38. (Original) The process of claim 28 further including:

sizing the particle, based either upon an amplitude of the first response, or upon a time of travel of the particle from the first location to the second location.

39. (Original) The process of claim 28 wherein:

said first and second beams are inactive when in the second state.

40. (Original) The process of claim 28 wherein:

the first and second beams are in a low amplitude operating mode when in their respective second states.

41. (Original) The process of claim 28 wherein:

at least one of the first and second responses includes fluorescent energy of a plurality of different wavelengths emitted by the particle, and detecting the at least one of the responses includes separately sensing the different wavelengths of the fluorescent energy.

42. (Original) A particle characterizing apparatus with controllable coherent energy sources, including:

a flow generating device for moving a particle-containing fluid along a designated path to carry the particles serially along the path;

a first source adapted to generate a first coherent energy beam positioned to intersect the designated path at a first location for a first irradiation of each particle as it travels along the path, said first source being operable to adjust the first beam between a first state comprising a high amplitude operating mode, and a second state comprising either a low amplitude operating mode or an inactive state, wherein the first source further is adapted to maintain the first beam primarily in the first state;

a second source adapted to generate a second coherent energy beam positioned to intersect the designated path at a second location downstream of the first location for a second irradiation of each particle as it travels along the path, said second source being operable to adjust the second beam between a first state comprising a high amplitude operating mode, and a second state comprising either a low amplitude operating mode or an inactive state;

a sensing component for detecting a first response comprising radiant energy emanating from the particle in response to the first irradiation, and adapted to generate a first signal upon said detecting; and

a control channel coupled to the sensing component to receive the first signal and coupled to the first source, adapted to cause the first source to switch the first beam from the first state to the second state in response to receiving the first signal.

43. (Original) The apparatus of claim 42 wherein:

the second source is adapted to maintain the second beam primarily in the second state, and the control channel further is coupled to the second source and adapted to cause the second source to switch the second beam from the second state to the first state in response to receiving the first signal.

44. (Original) The apparatus of claim 43 wherein:

the control channel further is adapted to cause the first and second sources to effect said switching at the end of a predetermined delay following receipt of the first signal.

45. (Original) The apparatus of claim 43 wherein:

the sensing component further is adapted to detect a second response comprising radiant energy emanating from the particle in response to the second irradiation, and to generate a second signal upon said detection.

46. (Original) The apparatus of claim 45 wherein:

the control channel further is coupled to receive the second signal, and adapted to cause the first source to reset the first beam to the first state, and further to cause the second source to reset the second beam from the first state to the second state, in response to receiving the second signal.

47. (Original) The apparatus of claim 45 wherein:

the sensing component consists of a single detector.

48. (Original) The apparatus of claim 45 wherein:

the sensing component includes a first sensor for detecting the first response, and at least one second detector for detecting the second response.

49. (Original) The apparatus of claim 45 wherein:

the sensing component is adapted to determine an intensity of at least one of the first and second responses, to indicate a size of the particle.

50. (Original) The apparatus of claim 42 further including:

a timing device for measuring a time of travel for the particle from the first location to the second location as an indication of particle size.

51. (Original) The apparatus of claim 42 wherein:

the first and second sources are controllable to respectively reduce the amplitudes of the first and second beams in their respective second states.

52. (Original) The apparatus of claim 42 wherein:

the first and second sources are controllable to deactivate the first and second beams to their respective second states.

53. (Original) The apparatus of claim 45 wherein:

at least one of the first and second responses comprises a plurality of different fluorescent energy wavelengths, and the sensing component includes a plurality of different channels to individually sense the different wavelengths.

54. (Original) A particle detection apparatus, including:

a flow generating device for moving multiple particles serially along a predetermined path;

a coherent energy source for causing a first beam having a first wavelength to intersect the predetermined path at a first location;

a coherent energy source for causing a second beam to intersect the predetermined path at a second location, the second beam having a second wavelength shorter than the first wavelength and selected to trigger a responsive emission dependent on particle composition; and

a detector disposed proximate the predetermined path to detect energy at the first wavelength scattered by the particle as it travels past the first location, and to detect energy including a third wavelength emitted by the particle in response to irradiation by the second beam as it travels past the second location;

wherein the third wavelength is longer than the second wavelength.

55. (Original) The apparatus of claim 54 wherein:

the detector is sensitive to the first wavelength and the third wavelength, and substantially insensitive to the second wavelength.

56. (Original) The apparatus of claim 54 wherein:

the detector is sensitive to fluorescent energy, and the energy emitted by the particle is fluorescent energy.

57. (Original) The apparatus of claim 54 further including:

a particle sizing component including at least one of: a means for measuring an intensity of at least one of the scattered energy and the emitted energy at the detector; and a means for determining a time of travel of the particle between the first and second locations.

58. (Original) The apparatus of claim 54 further including:

a control component for deactivating the first beam in response to sensing the scattered energy.

59. (Original) The apparatus of claim 58 wherein:

the control component is adapted to maintain the second beam primarily in an inactive state, and to activate the second beam in response to the sensing of the scattered energy.

60. (Original) The apparatus of claim 54 wherein:

the second location is downstream of the first location.

61. (Original) In an aerosol characterizing system including a first radiant energy beam irradiating aerosol particles at a first location along a path, a second radiant energy beam for irradiating the aerosol particles as they travel past a second location downstream of the first location, a first sensor adapted to detect energy scattered by the particles as they pass the first location and generating a first sensor output that varies with intensity of scattered energy, and a second sensor for detecting fluorescent energy emitted by each particle at the second location in response to irradiation by the second beam and generating a second output that varies with intensity of the fluorescent energy; a process for dynamically controlling the second sensor output, including:

detecting an amplitude of the first sensor output;

detecting an amplitude of the second sensor output;

detecting an amplitude of the second beam; and either:

(i) reducing the amplitude of the second beam, in response to detecting the first sensor output at an amplitude that exceeds a given maximum;

(ii) reducing a gain of the second sensor, in response to detecting the first sensor output at an amplitude that exceeds the given maximum; or

(iii) increasing an amplitude of the second beam according to a substantially linear ramp function while simultaneously monitoring a selected one of the second sensor output and the second beam amplitude, and clamping the ramp function when reaching a given maximum associated with the selected one.

62. (Currently Amended) A particle sizing system, including:

a flow generating device for moving multiple particles serially along a predetermined path and causing the particles to accelerate along at least part of the path;

a coherent energy source for causing a first beam to intersect the predetermined path at a first location;

a coherent energy source for causing a second beam to intersect the predetermined path at a second location spaced apart from the first location;

a first sensor positioned to detect energy at the first wavelength emanating from each of the ~~particle~~ particles in response to irradiation by the first beam as it travels past the first location;

a second sensor positioned to detect energy at a second wavelength emanating from each of the ~~particle~~ particles in response to irradiation by the second beam as it travels past the second location, wherein the second wavelength is different from the first wavelength; and

a timing component for determining a time for ~~the~~ each particle to travel between the first and second locations, based on the outputs of the first and second detectors, wherein the timing component is adapted to identify the output of an upstream one of the first and second detectors as a time measurement starting point and to identify the output of the other of the

sensors as a time measurement ending point, based on the difference in wavelengths of the energy detected by the first and second sensors, respectively.

63. (New) The process of claim 61 wherein:

the second sensor output is dynamically controlled by reducing the amplitude of the second beam in response to detecting the first sensor output at an amplitude that exceeds the given maximum.

64. (New) The process of claim 61 wherein:

the second sensor output is dynamically controlled by reducing a gain of the second sensor in response to detecting the first sensor output at an amplitude that exceeds a given maximum.

65. (New) The process of claim 61 wherein:

the second sensor output is dynamically controlled by increasing an amplitude of the second beam according to a substantially linear ramp function while simultaneously monitoring the second sensor output, and clamping the ramp function when reaching a given maximum second sensor output.

66. (New) The process of claim 61 wherein:

the second sensor output is dynamically controlled by increasing an amplitude of the second beam according to a substantially linear ramp function while simultaneously monitoring the second beam amplitude, and clamping the ramp function when reaching a given maximum second beam amplitude.

67. (New) The system of claim 62 wherein:

the first location along the predetermined path is upstream of the second location, and the first beam has a first wavelength longer than a second wavelength of the second beam.

68. (New) The system of claim 67 wherein:

the first wavelength is at least as long as a minimum wavelength of coherent energy in the ultraviolet range.

69. (New) The system of claim 67 wherein:

the first wavelength is at least as long as a minimum wavelength of coherent energy in the near infrared range.

70. (New) The system of claim 62 wherein:

the first sensor is adapted to detect energy at the first wavelength scattered by each of the particles in response to irradiation by the first beam, and the second sensor is adapted to detect energy at the second wavelength scattered by each of the particles in response to irradiation by the second beam.

71. (New) The system of claim 62 wherein:

the first sensor is adapted to detect energy at the first wavelength scattered by each of the particles in response to irradiation by the first beam, and the second sensor is adapted to detect energy at the second wavelength emitted by each of the particles in response to irradiation by the second beam.